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## EUROPEAN PATENT APPLICATION

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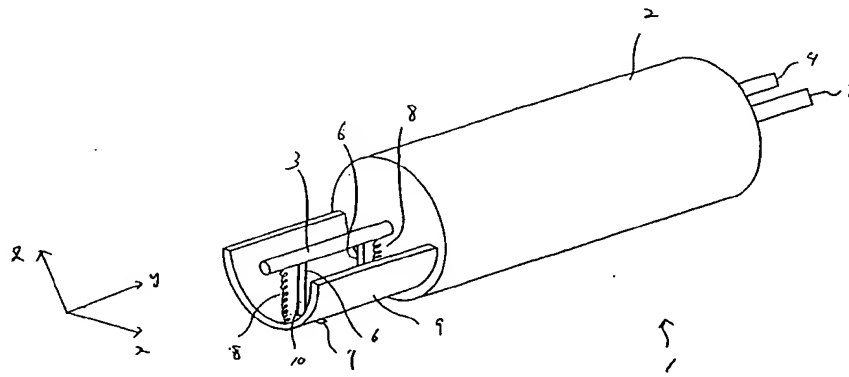
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**54** Vibration motor for obtaining a starting torque with a small current.

**57** The present invention is provided with a motor-(2) having a rotary shaft(3). A weight(9) is fixed to a motor(2) through guide pins(6) formed to the rotary shaft(3). Each of springs(8) has one end connected to the rotary shaft(3) and the other end connected to the weight(9). The guide pins(6) guide the vertical movement of the weight(9) with respect to the rotary shaft(3). Holes(10) are formed in the weight(9) and the guide pins(6) are pierced therethrough. A hook(7) is formed to a tip of each guide pin(6) to prevent the weight(9) from coming off the guide pins(6) when the weight(9) is rotated. With the above-described ar-

rangement, in the vibration motor(1) according to the present invention, the eccentric quantity of the weight(9) with respect to the rotary shaft(3) becomes small by the springs(8) when the rotation of the weight(9) is started. The starting torque of the motor-(2) can be, therefore, small. With the start of the rotation of the weight(9), the eccentric quantity of the weight(9) with respect to the rotary shaft(3) becomes large against the tension of the springs(8) by the centrifugal force of the rotation, and the vibration motor(1) can obtain a sufficient quantity of vibration.



The present invention relates to a motor, and more particularly to a motor generating vibrations.

A vibration motor of this type has been conventionally used in a selective calling receiver and others. The vibration motor in the selective calling receiver is used for informing a user of a call reception.

A conventional vibration motor is provided with a motor body having a rotary shaft. Further, a weight is attached to the rotary shaft. The weight is so disposed as to be eccentric with respect to the rotary shaft.

In the conventional motor, the rotary shaft is rotated with the electric power supplied from a motor power supply terminal. The rotation of the rotary shaft involves the rotation of the weight, and the vibration motor generates vibrations.

In the conventional vibration motor, however, since the weight is directly fixed to the rotary shaft, a large starting torque for rotating the weight is required. The motor power supply terminal must therefore supply a large amount of current to the motor body, and hence the selective calling receiver using the motor of this type requires a large scale power supply. The dimension of the selective calling receiver thus becomes large, deteriorating the portability.

In addition, as a prior art vibration motor, a vibration motor using ultrasonic vibrations produced by a piezoelectric device as a driving source has been also used. This type of motor is disclosed in Japanese Patent Laid-open No. heisei 2-111269 or Japanese Patent Laid-open No. showa 63-262069, for example.

This type of motor has however a complicated structure, thereby increasing the manufacturing cost.

An object of the present invention is therefore to provide a vibration motor being capable of obtaining a starting torque for a motor with a small current.

To achieve these aims, a vibration motor according to one aspect of the present invention includes a motor having a rotary shaft. A weight is provided to a motor through guide pins formed to a rotary shaft. One end of each spring is connected to the rotary shaft and the other end of the same is connected to the weight. The guide pins guide the movement of the weight with respect to the rotary shaft in the vertical direction. Holes are formed in the weight and the guide pins are pierced therethrough. A hook is formed to a tip of each guide pin in order to prevent the weight from coming off the guide pin when the weight is rotated.

With the above-described arrangement, in the vibration motor according to the present invention, the eccentric quantity of the weight with respect to the rotary shaft is reduced by means of the springs

when the rotation of the motor is started. As a result, the starting torque of the motor can be small. Upon starting the rotation of the weight, the eccentric quantity of the weight with respect to the rotary shaft becomes large against the tension of the springs by the centrifugal force of the rotation, and the vibration motor hence can obtain a sufficient quantity of vibration.

## BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects, features and advantages of the invention will become more fully apparent from the following detailed description taken in conjunction with the accompanying drawings.

Fig. 1 is a perspective view showing an embodiment according to the present invention;

Fig. 2 is a cross sectional plan view taken along the x-z plane shown in Fig. 1 when a motor is not rotated;

Fig. 3 is a side elevational view taken along the z-y plane shown in Fig. 1 when the motor is not rotated;

Fig. 4 is a side elevational view taken along the z-y plane shown in Fig. 1 when the motor is rotated; and

Fig. 5 is a bottom view taken along the x-y plane shown in Fig. 1 when the motor is rotated.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in Fig. 1, a vibration motor 1 according to the present invention is provided with a motor body 2 having a rotary shaft 3. A motor power supply terminal 4 is connected to a non-illustrated power supply to supply the electric power to the motor body 2. To the rotary shaft 3 are formed guide pins 6 each having a hook 7 at the tip thereof. Each guide pin 6 is formed to the shaft 3 in the substantially-vertical manner. The guide pin 6 is pierced through each hole 10 provided in a weight 9. The weight 9 is fitted to the shaft 3 by the contact made between the hook 7 and the weight 9 when the shaft 3 is rotated. Each spring 8 has one end connected to the shaft 3 and the other end connected to the weight 9. The weight 9 has a such shape that can be obtained by cutting a hollow cylinder in the vertical direction, and the aforesaid holes 10 are formed thereto.

The operation of the vibration motor will now be described with reference to Figs. 2 to 5.

Referring to Figs. 2 and 3, each spring 8 is contracted when the shaft 3 is not rotated, thus, the weight 9 has an impetus with respect to the shaft 3. Therefore, when the rotation of the shaft 3 involves the rotation of the weight 9 in this state, the starting torque can be small and the weight can be

rotated with a small amount of current. The rotation of the shaft 3 provokes the expansion of each spring 8. With the expansion of the spring 8, the weight 9 is moved toward the lower portion in the drawings along the guide pins 6. The eccentric quantity with respect to the shaft 3 thus becomes large, thereby producing a sufficient quantity of vibration.

After the elapse of a predetermined time from the start of the rotation of the shaft 3, as shown in Fig. 4, the spring 8 is fully expanded. At this time, even when each spring 8 is completely expanded and the maximum eccentric quantity of the weight 9 with respect to the shaft 3 is obtained as shown in Figs. 4 and 5, the weight 9 does not protrudes from the shaft 3 to come off since the hooks 7 come into contact with the weight 9.

As described above, since the eccentric quantity of the weight 9 with respect to the shaft 3 is small when the rotation of the shaft 3 is started, the rotation of the weight 9 is started by only supplying a small amount of current to the power supply terminal 4. When the rotation of the weight 9 is once started, the weight 9 is moved along the guide pins 6 against the tension of the springs 8 so as to be away from the shaft 3 by the centrifugal force of the rotation. At this time, although the inertial force acts on the weight 9 in the direction opposed to that of the rotation with the increase in the rotational speed, the inertial force is offset by the contact made between the weight 9 and the guide pins 6. The weight 9 is gradually moved away from the shaft 3 when the rotation is started and moved to the position where the weight 9 is brought into contact with the hooks 7. At this time, the eccentric quantity is, therefore, sufficiently large in comparison with that attained when the rotation of the weight 9 is started, thereby obtaining a sufficiently large quantity of vibration.

Obviously, numerous additional modifications and variations of the present invention are possible in light of the above teachings. It is, therefore, to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described herein.

### Claims

1. A vibration motor(1) comprising a motor(2) and a weight(9), characterized by eccentric means(8) for increasing an eccentric quantity of said weight(9) with respect to a central axis of said motor with a rotation of said weight(9).
2. The vibration motor as claimed in claim 1, said vibration motor(1) characterized in by a guide pin(6) for guiding a movement of said weight(9) involved in an increase in said eccentric

quantity.

3. The vibration motor as claimed in claim 1 or 2, characterized by a rotary shaft (3) being connected to said central axis of said motor (2).
4. The vibration motor as claimed in any of claims 1 to 3, characterized in that said eccentric means further comprises a spring(8) having one end connected to said rotary shaft(3) and the other end connected to said weight(9).
5. The vibration motor as claimed in any of claims 2 to 4, characterized in that said weight (9) includes a hole (10) through which said guide pin (3) is pierced, and said vibration motor further comprises a hook (7) which is formed at a tip of said guide pin(3) and prevents said weight(9) from coming off said guide pin(3) when said weight(9) is rotated.
6. A vibration generation method using a vibration motor(1), the method comprising the steps of maintaining an eccentric quantity of a weight(9), which is respected to a central axis of a motor(2), to be small, starting a rotation of said weight(9), and enlarging said eccentric quantity with said rotation of said weight(9).
7. The vibration generation method using a vibration motor(1) as claimed in claim 6, further comprising the step of keeping said eccentric quantity constant with said rotation of said weight(9).

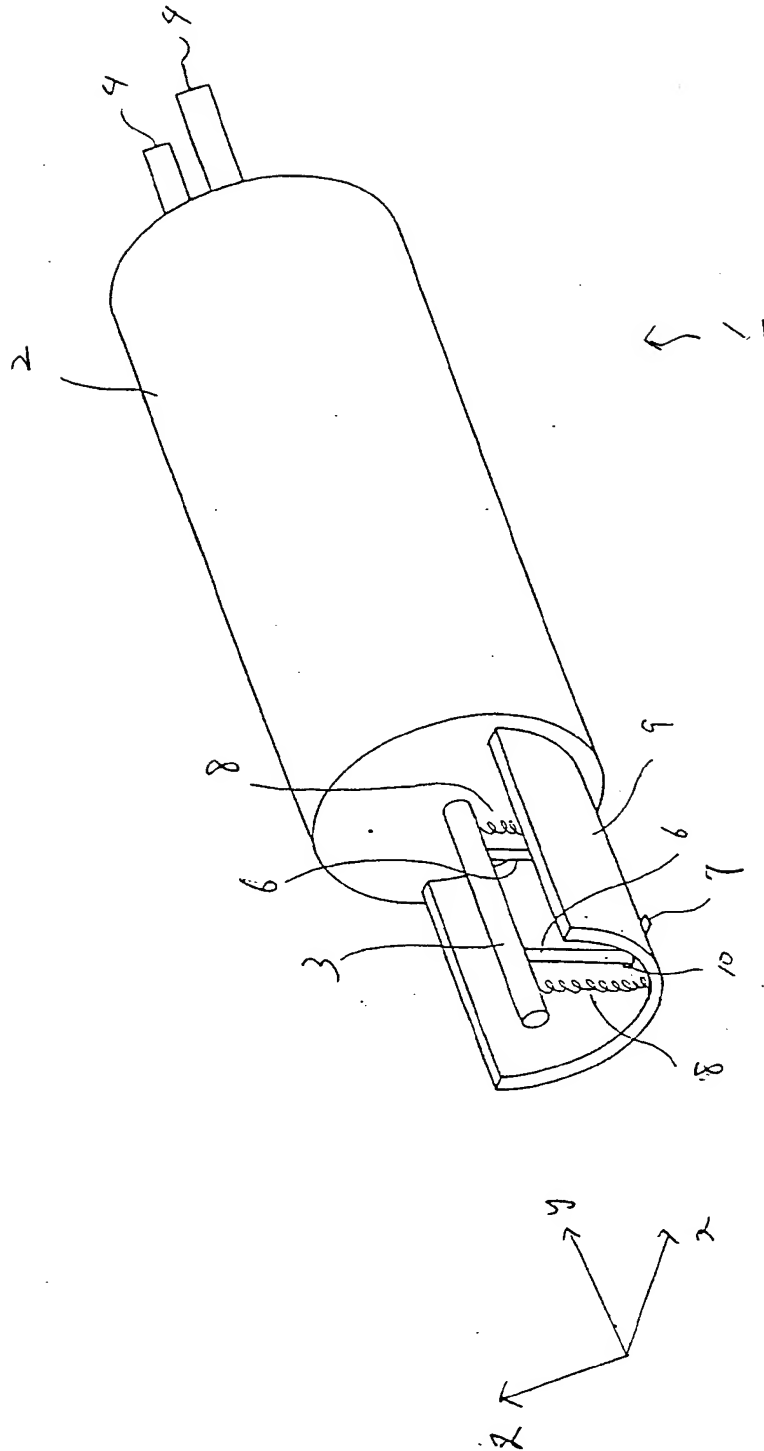


FIG. 1

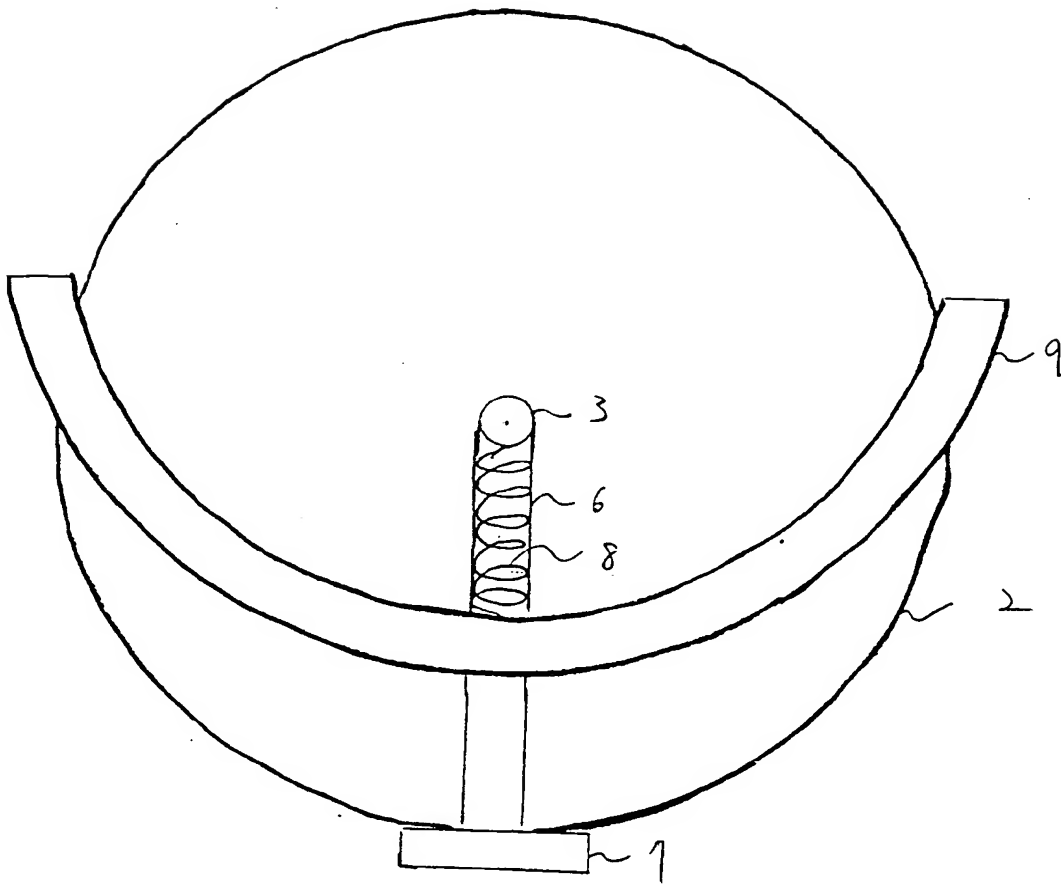


Fig. 2

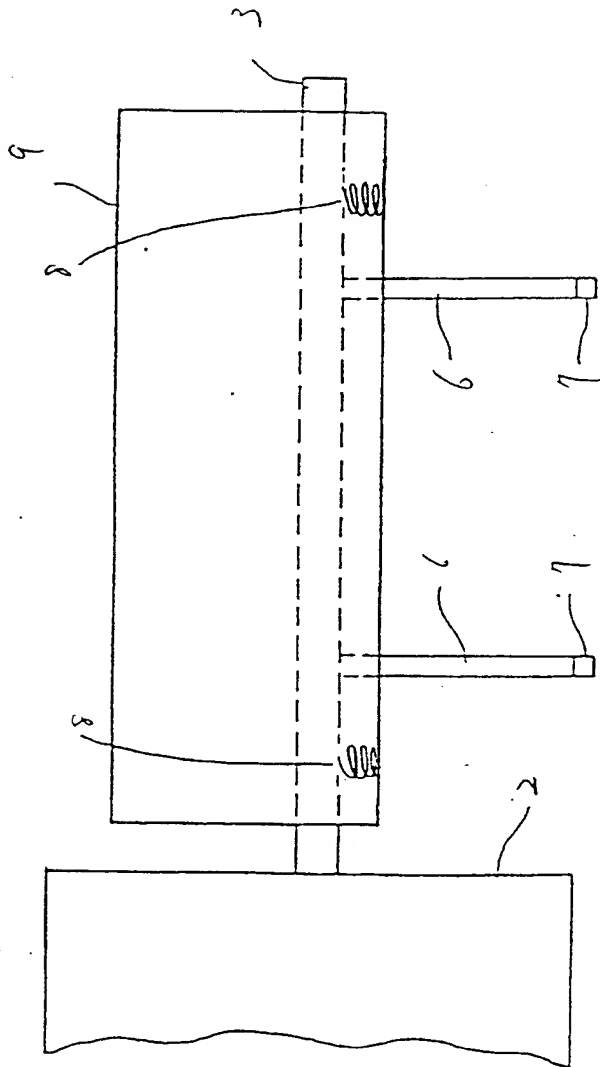


Fig. 3

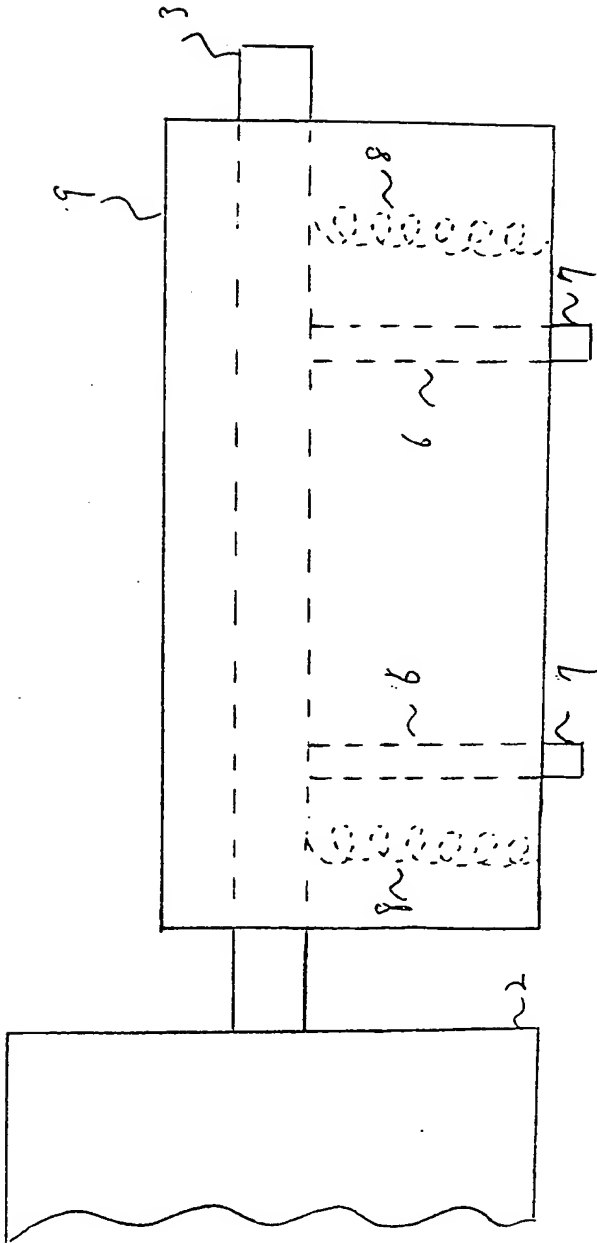


FIG. 4

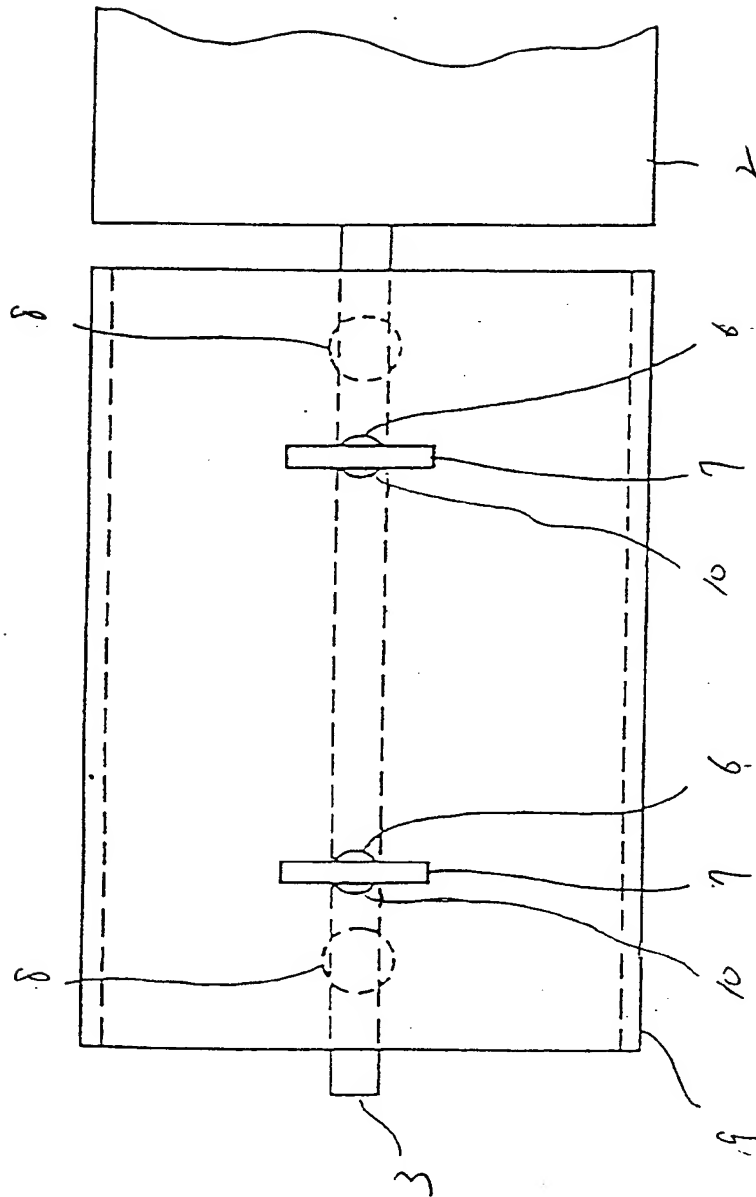


Fig. 5-



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# EUROPEAN SEARCH REPORT

Application Number  
EP 95 10 1702

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US-A-3 911 416 (FEDER ALVIN) 7 October 1975 * the whole document *	1,3,6,7	H02K7/06 B06B1/16
Y	---	2,4,5	
Y	GB-A-862 591 (PLOWRIGHT) * the whole document *	2,4,5	
X	DE-A-18 04 955 (MEYER) 22 May 1969 * page 4, paragraph 2 - page 5, paragraph 2; figures 1-1B *	1,3,6,7	
A	-----	2,4,5	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			H02K B06B G08B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 24 May 1995	Examiner Zanichelli, F
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ..... & : member of the same patent family, corresponding document	

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